

# Brazos Safety Systems: Weather System

**Authors:** Iyed Acheche, Oscar Arenas, Nagendra Chaudhary, Evan Eissler, Robbie Hannaford, Tucker Rinaldo, Sumalee Rodolph  
**Advisor:** Dr. Ipser

## Background

The Brazos Safety Systems Weather Application provides insight into weather conditions that affect aviation operations. Weather plays a critical role in flight safety, and understanding conditions during flight operations can help explain incidents or risky behavior that occur. The application integrates aviation weather data sources, including METAR reports and radar imagery, to visualize weather conditions around airports and during historical flights. Users can upload flight records and review the weather conditions associated with those flights through the application. By presenting aviation weather data in a centralized and accessible format, the application supports post-flight analysis and helps identify weather-related factors associated with flight incidents. The goal is to provide insights that assist in understanding past flight conditions and help prevent similar issues in future aviation operations.

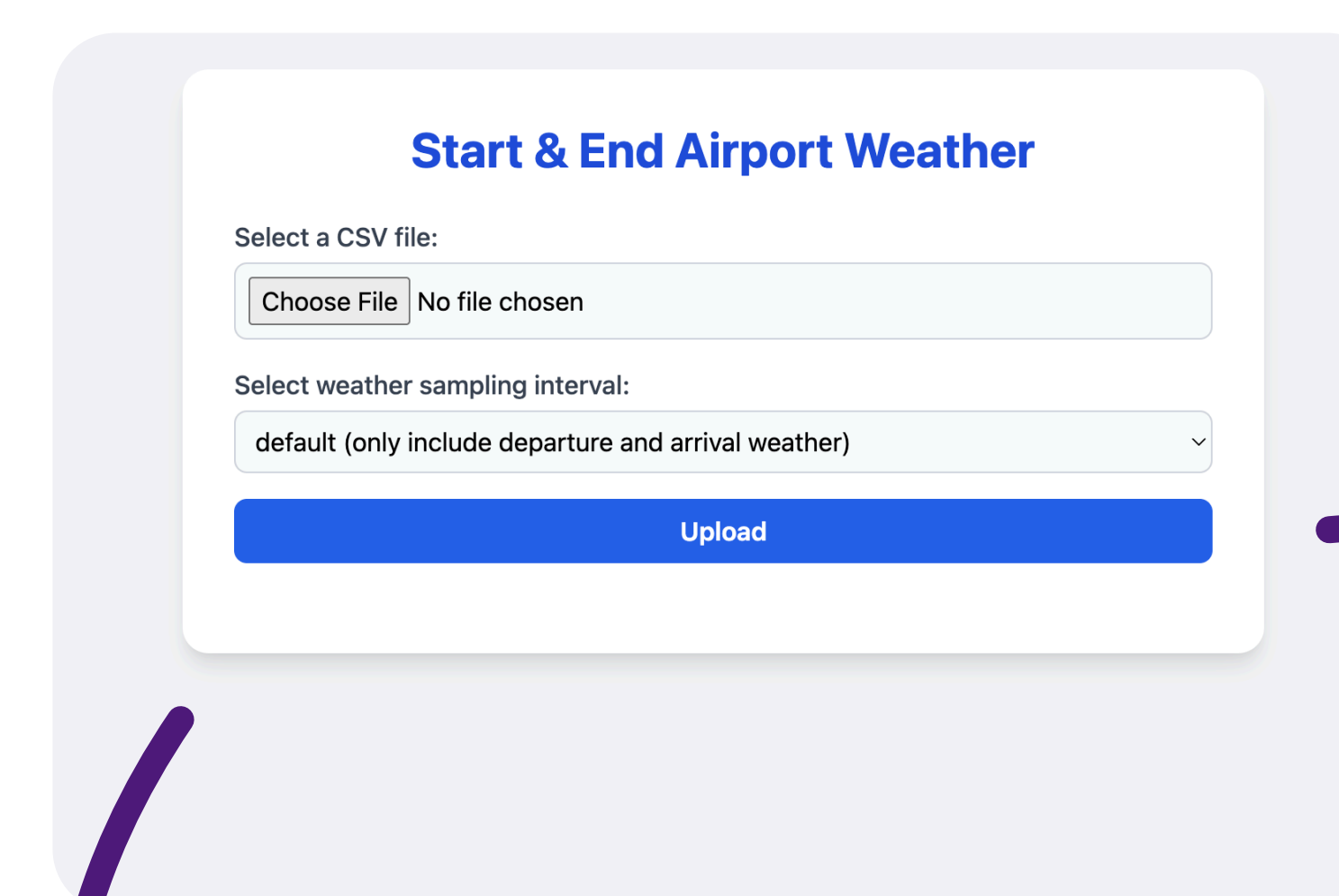
## Outcomes

We are proud to share that after a great deal of hard work, we successfully delivered a working solution to our client well ahead of the deadline. Our solution consists of a Python-based Django web application that accurately processes flight data and provides users with a clean, intuitive experience for viewing visualizations. We built two visualization engines on top of an Iowa State weather API: a 3D flight path that guides the viewer through the aircraft's entire flight, complete with real clouds, snow, and rain along the route, and a 2D radar map. The radar map offers a broader perspective, displaying the flight path alongside accurate, minute-by-minute visualizations of precipitation surrounding the aircraft. We are proud to have contributed to this project, and we hope that our work will enable future flights to be analyzed more thoroughly, offering greater insight into incidents with the ultimate goal of advancing aviation safety standards.

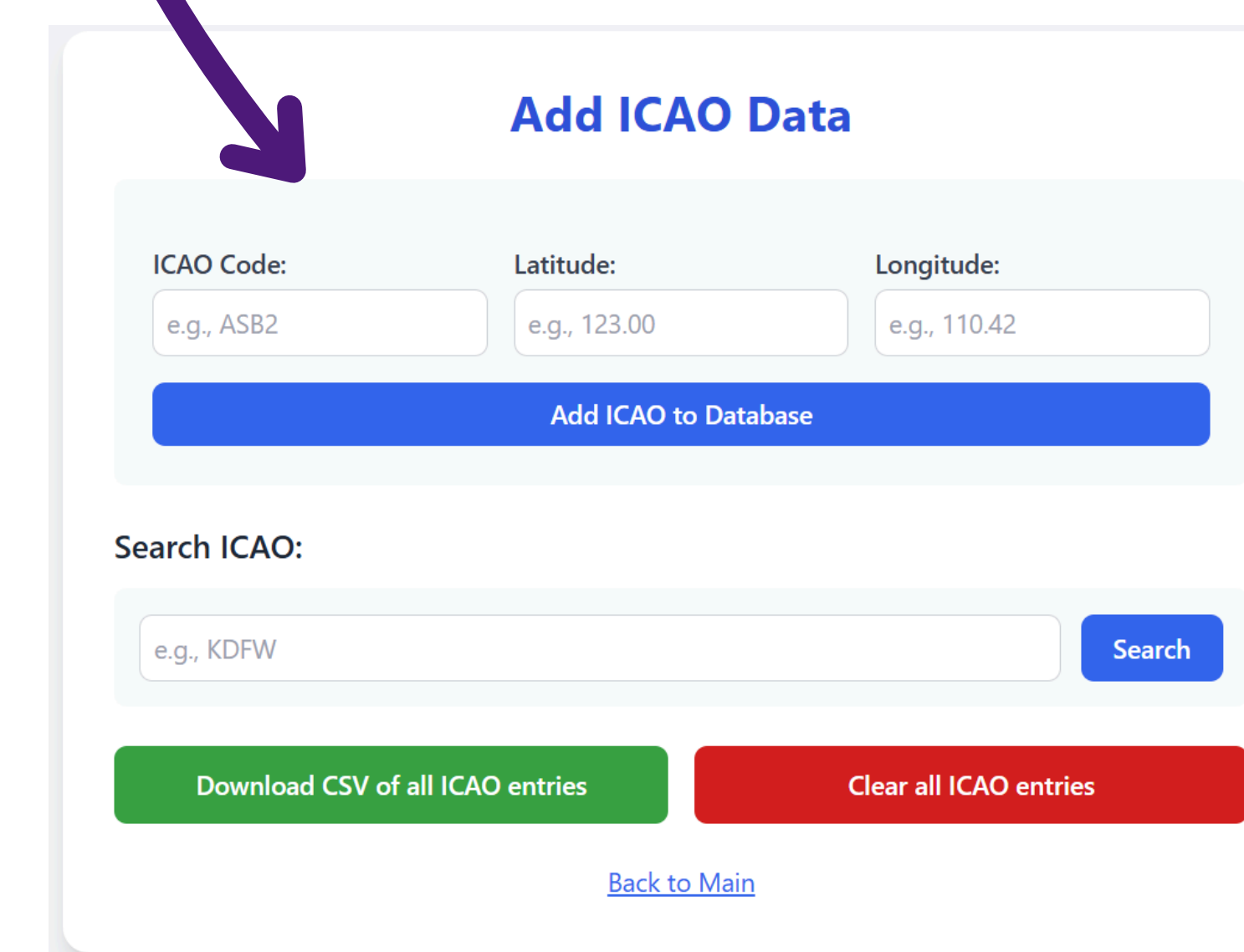
## Challenges

Throughout the course of this project, we encountered many challenges. Some required minor updates while others forced us to step back and rethink our approach entirely. One of the most significant challenges was finding a reliable weather API and calling it correctly. The team built out much of the framework around one API, but after several weeks of testing we discovered that it wasn't returning the correct data. When sending it past dates, it would consistently return the current weather at the station instead. We had assumed it was working as intended, but the results were completely inaccurate. After further research, the team was able to identify a different API that returned the proper weather information, though this required us to restructure the code to accommodate it. Another challenge came with building the visualizations. The tool we used, Cesium, is highly complex and, while incredibly powerful, getting things to look right proved to be quite difficult.

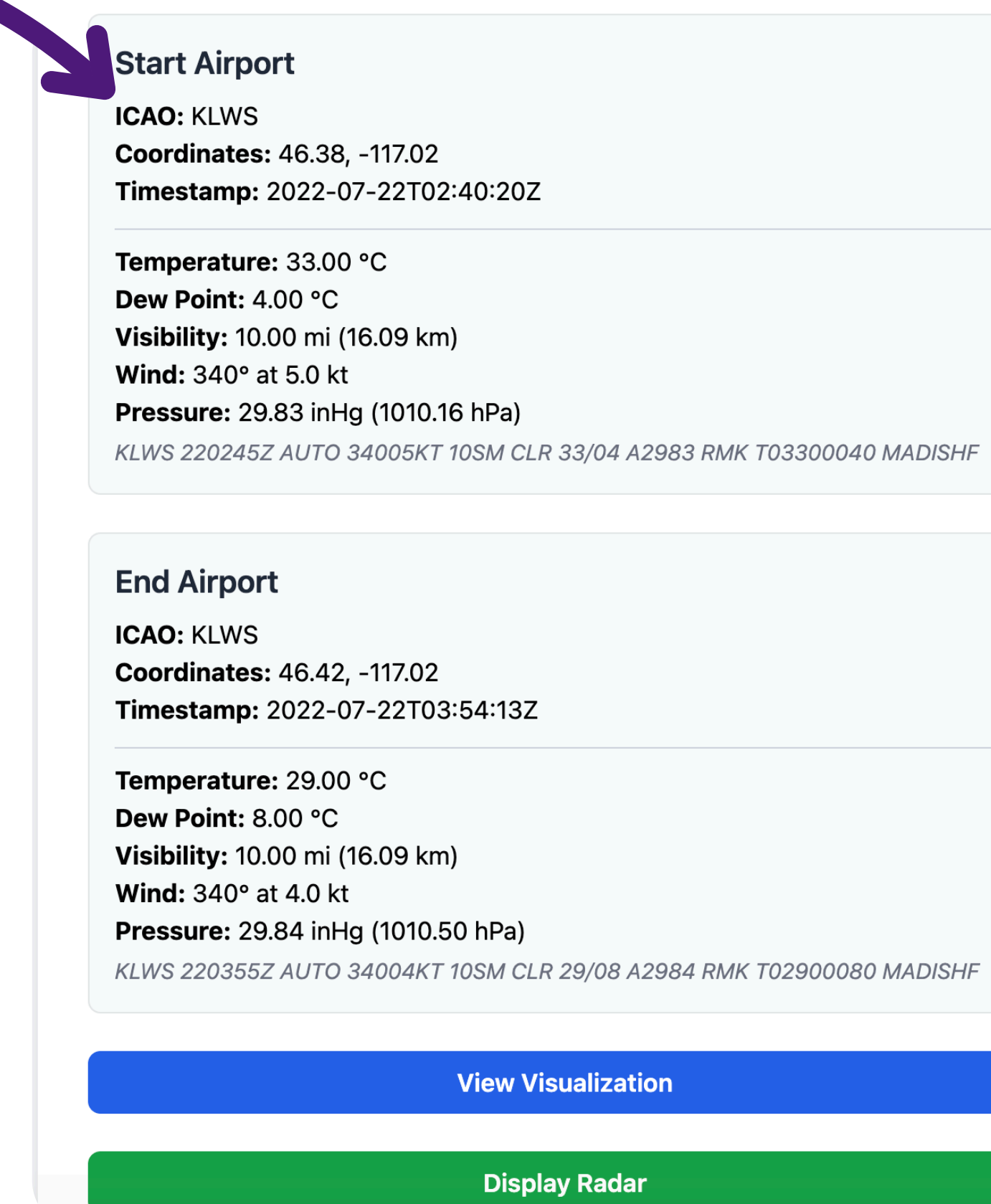
## User Interface and Experience



Start menu



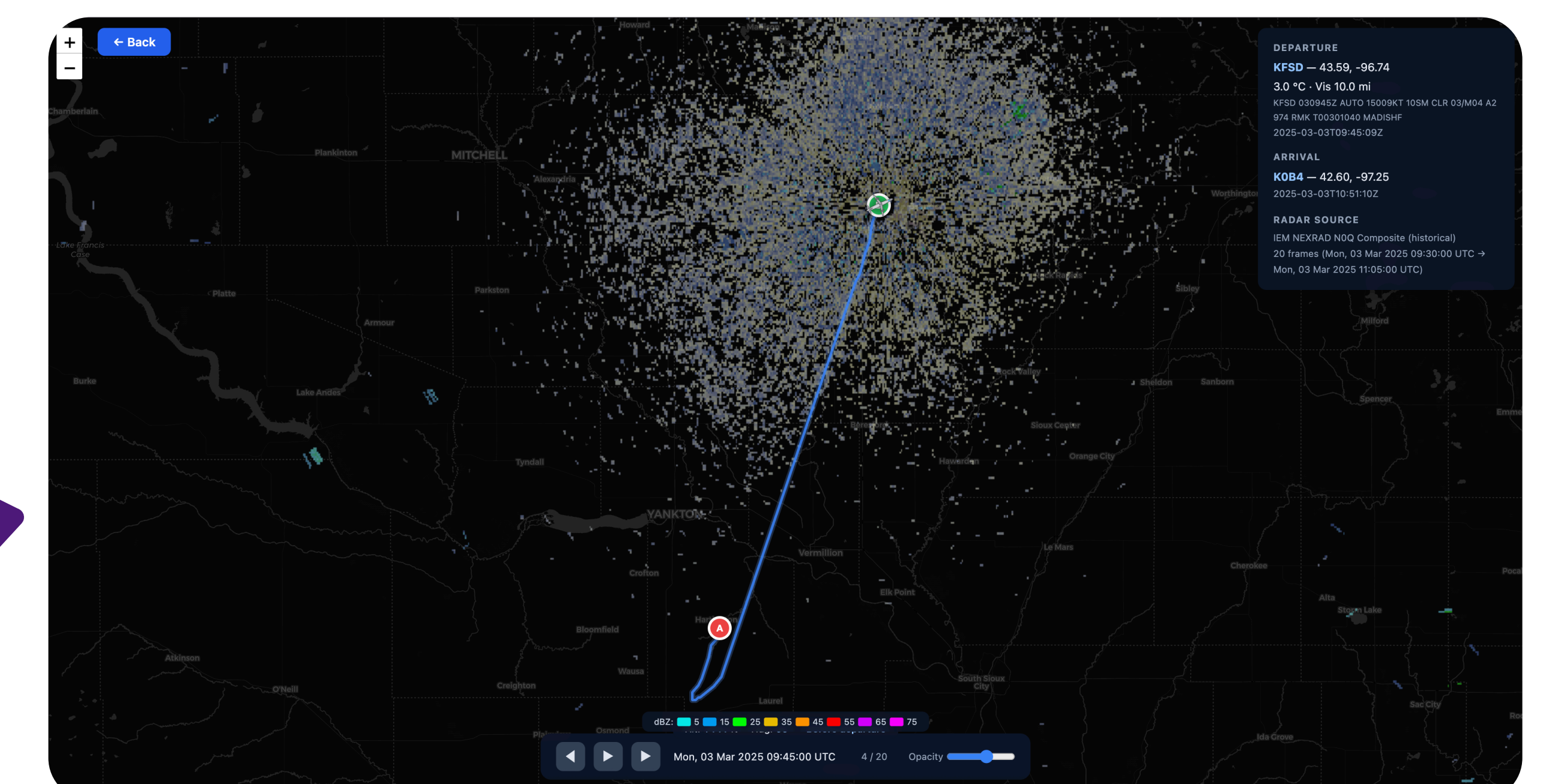
Admin menu



ICAO View menu



Weather View



Radar View

## Tech Stack

Database



User Interface



Backend



## Acknowledgments

We would like to extend our sincere thanks to Tracy Welterlen and Brazos Safety Systems for their exceptional support, insight, and collaboration throughout this project. Their involvement was invaluable and greatly contributed to the success of our work. Their willingness to share industry knowledge and real-world perspectives helped ground our work in practical application and pushed us to think critically about the challenges we were solving. We also thank Dr. Ipser for his thoughtful guidance and valuable feedback along the way. Additionally, we are grateful to Dr. Wei for organizing this project and for giving us the opportunity to take on a challenge as meaningful and rewarding as this one. Lastly, we extend our appreciation to the TCU College of Science & Engineering for providing a strong academic environment that fosters innovation, technical growth, and hands-on learning, and for preparing us to take on real-world problems like this one.